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BITTERBRUSH ECOLOGY--SOME RECENT FINDINGS[1/]

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Bitterbrush (Purshia ssp.) is an important element of range grazing capacity in the West. This browse shrub provides premium forage on many important winter-deer ranges and is a valuable part of the diet of many animals. But the shrubs have been destroyed or damaged over large areas by fire, heavy grazing by livestock and game, insect defoliation, girdling by mice, adverse weather conditions, and possibly other unknown factors. Natural reproduction is not enough in many places to sustain existing stands. Methods must be developed to maintain or improve the stands.

Research on the ecology of bitterbrush has yielded new information that should be considered in restoring such stands--information about its distribution, about soil characteristics where it occurs, and about its growth and reproduction. An ecological study in California is part of a cooperative project seeking to determine methods of seeding bitterbrush and other desirable browse plants where they are needed but not now growing.

The study is primarily concerned with antelope bitterbrush (P. tridentata), because it is one of the most widely distributed of all western shrubs. In many places it is regarded as the most important single browse species (U. S. Forest Service, 1937). The palatability of bitterbrush is usually good to excellent for cattle, sheep, and goats, as well

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as for deer, elk, antelope, bighorn sheep, and other game animals. The seed is important in the diet of rodents and birds. The study is also giving attention to desert bitterbrush (P. glandulosa), to intergrades between the two species, and to a possible intergeneric hybrid.

Distribution

The two bitterbrush species, antelope bitterbrush and desert bitterbrush, generally occupy separate ranges (fig. 1). Antelope bitterbrush is distributed on about 7.5 million acres east of the Sierra Nevada and Cascade Range in California at elevations between 3,500 and 11,500 feet (Hormay, 1943). The annual precipitation in this belt averages between 10 and 20 inches. This species commonly covers large areas associated with big sagebrush (Artemisia tridentata), Jeffrey, ponderosa, and pinyon pines (Pinus jeffreyi, P. ponderosa, and P. monophylla), and Sierra juniper (Juniperus occidentalis).

Desert bitterbrush predominates farther south. It extends over about 1 million acres, most frequently on alluvial fans and foothills adjacent to the Sonoran desert at elevations between 3,500 and 10,000 feet. Where the total annual rainfall ranges between 4 and 12 inches, this species is commonly associated with big sagebrush, blackbrush (Coleogyne ramosissima), singleleaf pinyon pine, and California juniper (J. californica). Sometimes it occurs with Joshua tree (Yucca brevifolia), creosote bush (Larrea divaricata), and honey mesquite (Prosopis chilensis). Communities of desert bitterbrush are infrequent and often isolated from other plants of the same species. This isolation is significant to plant development; edaphic or ecotypic variants may exist under such conditions and may well serve distinct niches in game-range revegetation.

Soil Characteristics

Both bitterbrush species grow on soils developed from a variety of different parent materials, including granitic, rhyolitic, basaltic, pumiceous or sedimentary sandstone, and shale rock. The soils have either been weathered in place from underlying bedrock or they have been transported by running water, glaciers, wind, or as volcanic ejecta (Gardner, 1956). In many places the transported material originated in high, mountainous areas where precipitation and leaching were considerably greater than in the drier deposition areas.

Bitterbrush grows best on coarse textured soils that are excessively drained, rapidly permeable throughout, and give a slightly acid soil reaction to a depth of 5 feet or more (fig. 2). Natural communities occur where the soil reaction is between pH 6.0 and 7.3 to a depth of at least 3 feet. The species do not generally develop where the soil is either saline or calcareous within 3 feet of the surface or where the soils are either imperfectly or poorly drained.

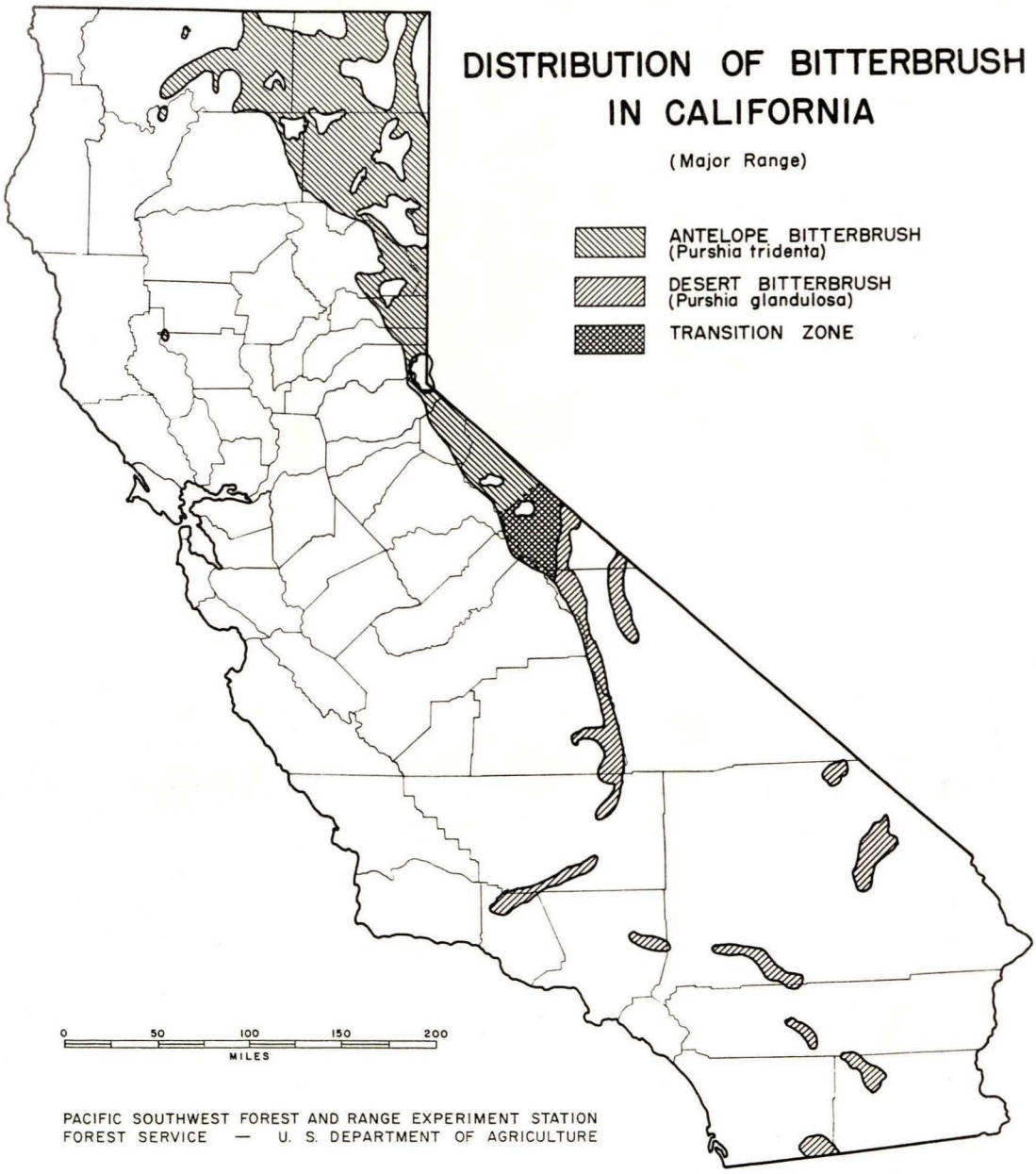


Figure 1.--Distribution of bitterbrush in California. Antelope bitterbrush ranges through the eastside mountains and basin areas. Desert bitterbrush grows mostly on foothills bordering on Sonoran desert.

Figure 2.--Tall, massive stands of bitterbrush occur on the deeper, coarser-textured soils deposited at the foot of the mountains.

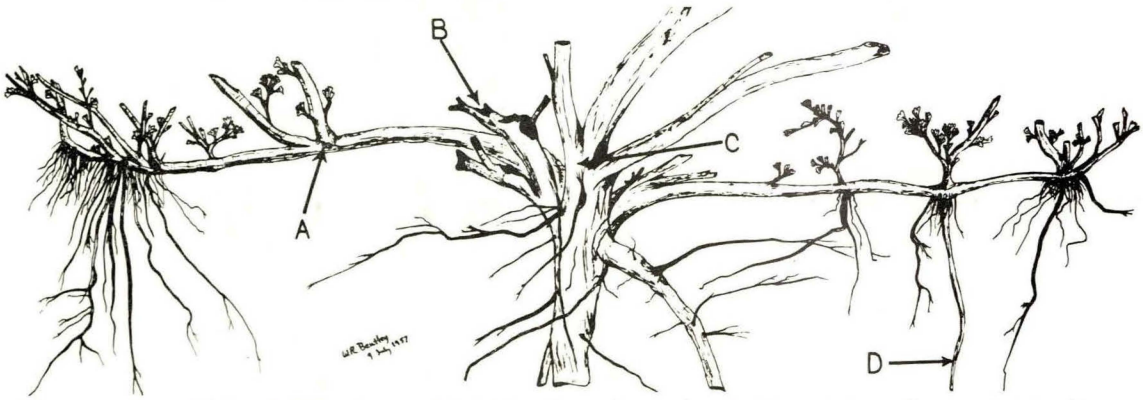
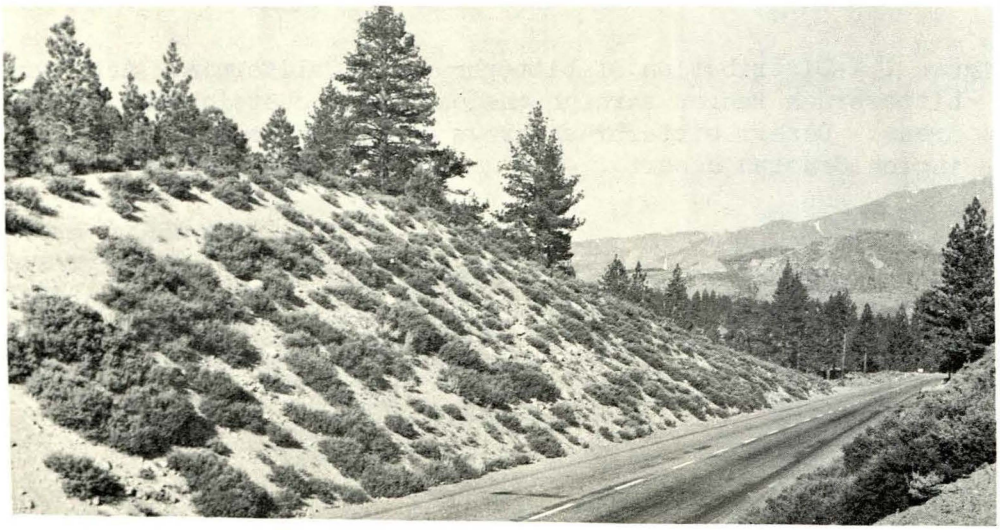


Figure 3.--Stem layering of bitterbrush. A, bud masses formed on the branches; B and C, fire scars on burned branches and crown; D, roots formed on the lateral branches. (Drawing by W. R. Bentley)

Figure 4.--Road cut stabilized by bitterbrush plants.



Reproduction

Bitterbrush spreads mostly by seed and less frequently by sprouting or stem layering. Most seedlings develop from rodent cached seed (Hormay, 1943). At the higher elevations where moisture is favorable, there may be as many as 10,000 plants per acre less than 5 years old. In most places, however, natural reseeding is usually much less and may be completely lacking.

New plants formed from stem layers help to maintain or improve natural stands. I have found more than 20 percent of the plants in several communities with well established roots along the branches. This rooting develops from bud masses formed on the outstretched branches where they touch the duff or soil (fig. 3). Because new plants become established from layers as well as seed, bitterbrush is an excellent soil stabilizer on adapted sites. Many examples are found along roadcuts, stream washes, and "blowouts". Long before other plants appear, bitterbrush often invades disturbed areas and for many years may provide the only form of soil cover and protection (fig. 4).

Resprouting of antelope bitterbrush after burning or cutting is relatively infrequent. I know of only one location in California where 25 percent or more of the plants resprouted after a burn. This happened after an early January fire; a most unusual time for burns on the eastside ranges. Burning conditions in this case are unknown. It is assumed the fire did not generate enough heat to injure the plants. A hot burn in summer usually destroys everything.

Desert bitterbrush, on the other hand, resprouts frequently and abundantly. This has occurred on every burned area examined in California, and according to Plummer (1957) resprouting occurs in other western states. Studies are still continuing to determine if resprouting after fire is due to the genetic makeup of the species or to other conditions.

Integration and Hybridization

Forms intermediate between the two bitterbrush species are common where their ranges come together or overlap (fig. 1). The integrated plants predominantly resemble antelope bitterbrush, but they retain the depressed glands characteristic of desert bitterbrush.

A naturally occurring hybrid between bitterbrush and Stansbury cliffrose (Cowania mexicana var. stansburiana), has been found. The earliest known collection of the plant was by C. A. Purpus in 1898 on Mowrey Peak, Nevada. He considered it a cross between desert bitterbrush and Stansbury cliffrose. It has been found growing at other locations and subsequently identified as a cliffrose variety: C. mexicana var. dubia (McMinn, 1951). In honor of the first known collector of the plant, I will henceforth call it Purpus cliffrose.

Fruiting characteristics of Purpus cliffrose are intermediate between the other two species. It bears 2 pistils on each receptacle, whereas Stansbury cliffrose has from 5 to 10 and bitterbrush usually has 1 but sometimes as many as 4. Also, the plumes on the achenes of Purpus cliffrose are intermediate in length (figs. 5 and 6). Some leaf dimorphism like that on bitterbrush prevails.

Natural hybridization of antelope bitterbrush and Stansbury cliffrose occurs in other areas (Plummer, 1957). Whether these plants are the same or another unidentified member of the genus complex has not been determined. Final verification must await more detailed genetic studies. Since this phenomenon occurs in nature it suggests a way to develop new browse strains or species that may well be superior for game range restoration. The first step in this direction has already been taken. A browse seed orchard has been established at the San Joaquin Experimental Range nursery where selected browse plants may now be brought together and propagated to produce seed and other materials for study and ultimate adaptation tests elsewhere.

Age of Bitterbrush

Some bitterbrush plants live to be at least 160 years old. Plants suspected of even greater age are rather common. Accurate determination, however, is precluded because of stem decay which obliterates some of the annual growth rings. The average age of observed plants in several communities ranged between 32 and 44 years. In general, plants on the winter-deer ranges were older, taller, and had larger crown area than plants growing on either summer or spring-fall ranges. The difference in growth is attributed to site conditions and to the smaller number of young plants growing on the winter ranges.

Summary

Ecological studies on bitterbrush in California show the two species occupy separate geographical ranges. Antelope bitterbrush is found mostly in the north; desert bitterbrush prevails in the south. Both prefer coarse textured soils that are well drained, non-calcareous, and are slightly acid to neutral.

Bitterbrush propagates mostly by seed but vegetative reproduction from stem layers contributes to stand maintenance. Antelope bitterbrush rarely resprouts after burns; desert bitterbrush frequently and abundantly resprouts.

Integrated plant forms appear where the two bitterbrush species occur together. There is evidence showing bitterbrush may hybridize with Stansbury cliffrose. The Purpus cliffrose is an example of this cross.

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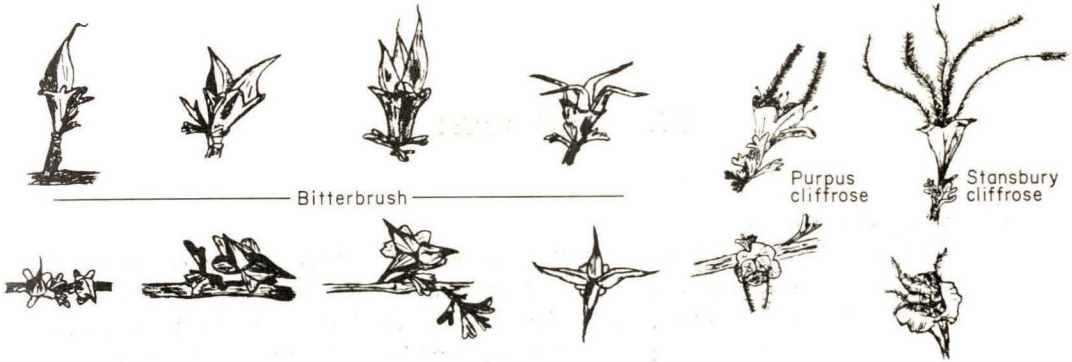

Figure 5.--Fruiting characteristics of bitterbrush, Purpus cliffrose, and Stansbury cliffrose. Bitterbrush has mostly 1 but sometimes has 3 or 4 fruit on a receptacle; Purpus cliffrose has 2 and Stansbury cliffrose has 5 to 10. (Drawing by W. R. Bentley)

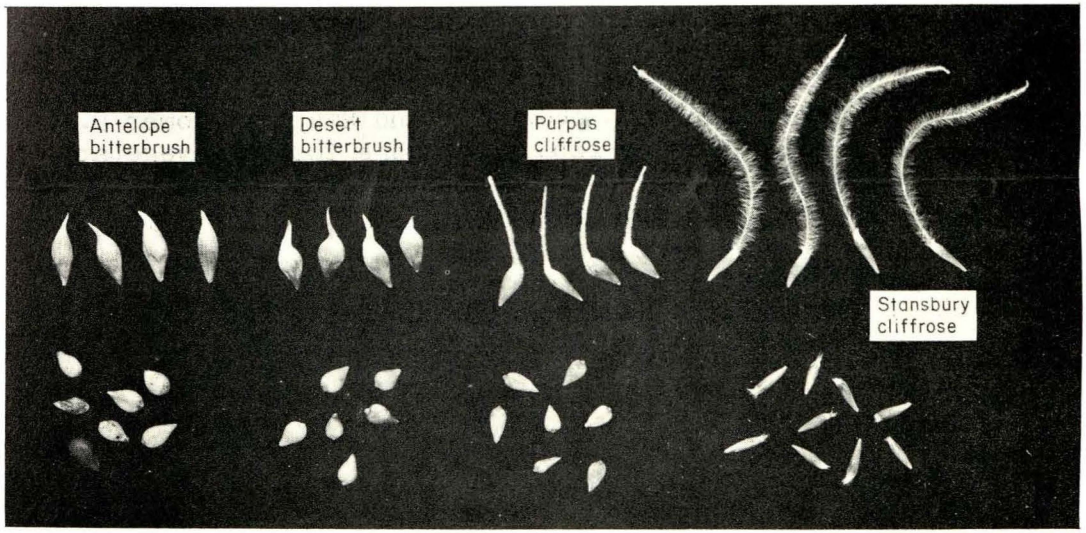

Figure 6.--Fruit and seed of the same plants shown in figure 5. Left to right: Antelope bitterbrush, desert bitterbrush, Purpus cliffrose, and Stansbury cliffrose. The plumes on Purpus cliffrose are intermediate, however, the seeds resemble bitterbrush.

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